

MIS Item Material Balance ICPAES/-MS vs. XRF

94-1 R&D Technical Review

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Actinide and Fuel Cycle Technology (NMT-11)



Items Evaluated To Date by XRF

ARF295

Hanford's, oxide from pyrochemical process, orig. from RFETS

C1407

RFETS, by-product, PuU oxide, hydride operations

K2141

RFETS, screenings from Pu oxidation

O3038

RFETS, by-product, PuU oxide, hydroxide precipitation

R437

Hanford's, Mg(OH)2 precipitation from nitrate solution

R440

Hanford's, Mg(OH)2 precipitation from nitrate solution

S1856

RFETS, peroxide precipitation/calcination

X2165

RFETS, dissolution residuals from foundry and scrap oxide

ARF295

	XRF1	XRF2	ICPAES	CAL/ISO
			ICPMS	
	weight %	weight %	weight %	weight %
ALUMINUM	0.70	0.69	0.55	
AMERICIUM	0.22	0.25	-	0.20
CALCIUM	0.45	0.48	0.09	
CHLORINE	6.93	6.32	7.10	
CHROMIUM	3.77	3.73	1.33	
COPPER	0.23	0.21	0.11	
GALLIUM	1.10	1.21	0.70	
IRON	11.13	10.92	5.40	
MAGNESIUM	2.53	3.93	4.04	
MANGANESE	2.53	3.93	-	
NICKEL	7.21	7.26	4.09	
PHOSPHOROUS	-	-	-	
PLUTONIUM	49.91	51.13	-	39.48
POTASSIUM	3.46	2.91	2.33	
SILICON	0.69	0.67	0.28	
SODIUM	2.00	2.75	2.36	
SULPHUR	-	-	0.02	
TANTALUM	0.90	0.92	0.01	
TIN				
TITANIUM	0.12	0.12	-	
TUNGSTEN	0.56	0.55	-	
URANIUM	0.21	0.16		
ZINC	-	-	0.03	
ZIRCONIUM	-	-	-	



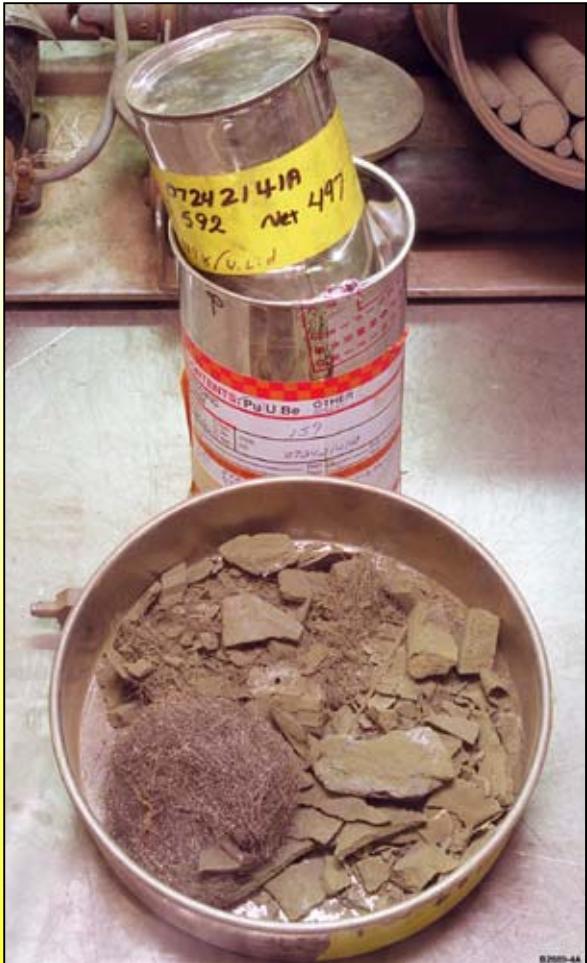
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C1407



	XRF1	ICPAES	ICPMS	CAL/ISO
	weight %	weight %	weight %	weight %
ALUMINUM			0.01	
AMERICIUM	0.43			0.18
CALCIUM		0.01		
CHLORINE				
CHROMIUM	0.14	0.09	0.10	
COPPER		0.03	0.02	
GALLIUM	0.96	0.08		
IRON	0.12	0.01	0.01	
MAGNESIUM		0.01	0.16	
MANGANESE		0.01	0.01	
NICKEL	4.29	2.68	3.10	
PHOSPHOROUS	0.99	0.08	0.01	
PLUTONIUM	81.95			65.10
POTASSIUM		0.01		
SILICON		0.03		
SODIUM				
SULPHUR	0.84	1.20		
TANTALUM		0.00	0.01	
TITANIUM	0.40	0.24	0.38	
TUNGSTEN	0.15	0.01	0.06	
URANIUM	17.93	5.57	0.59	11.70
ZINC				
ZIRCONIUM				

K2141



	XRF1	XRF2	ICPMS	CAL/ISO
	weight %	weight %	weight %	weight %
ALUMINUM	0.31	0.30	?	
AMERICIUM	0.43	0.37	?	0.22
CALCIUM	0.95	0.98	?	
CHLORINE			?	
CHROMIUM	0.87	0.80	?	
COPPER	-	0.10	?	
GALLIUM	0.52	0.90	?	
IRON	3.03	3.01	?	
MAGNESIUM			?	
MANGANESE	-	-	?	
NICKEL	0.16	0.17	?	
PHOSPHOROUS			?	
PLUTONIUM	88.55	86.24	?	43.95
POTASSIUM			?	
SILICON	1.16	1.67	?	
SODIUM			?	
SULPHUR	-	-	?	
TANTALUM			?	
TITANIUM			?	
TUNGSTEN			?	
URANIUM			?	
ZINC	-	-	?	
ZIRCONIUM			?	

O3038

	XRF1	XRF2	ICPMS	CAL/ISO
	weight %	weight %	weight %	weight %
ALUMINUM	0.60	0.60		
AMERICIUM				1.14
CALCIUM	8.60	8.70	3.20	
CHLORINE	36.30	31.90	4.50	
CHROMIUM	1.10	1.30	1.30	
COPPER				
GALLIUM				
IRON	4.80	5.50	3.40	
MAGNESIUM				
MANGANESE	-	0.10		
NICKEL	0.20	0.20	0.60	
PHOSPHOROUS				
PLUTONIUM	33.50	42.60		65.20
POTASSIUM	4.70	4.00	1.40	
SILICON	0.20	4.00	0.18	
SODIUM				
SULPHUR				
TANTALUM	0.60	0.30	0.01	
TITANIUM				
TUNGSTEN				
URANIUM	1.30	4.10		1.49
YTTRIUM			0.20	
ZINC				
ZIRCONIUM				



R437



*Sample is saturated in both AES and MS

	XRF1	ICPAES	ICPMS	CAL/ISO
	weight %	weight %	weight %	weight %
ALUMINUM	1.56	1.27	0.86	
AMERICIUM	0.24			0.29
CALCIUM	0.51	0.33		
CHLORINE				
CHROMIUM	0.68	0.35	0.43	
COPPER	0.15	0.66	0.74	
GALLIUM		-		
IRON	5.03	3.04	3.36	
MAGNESIUM	37.18	6.38	-	
MANGANESE	0.91	0.51	0.56	
NICKEL	0.77	0.49	0.59	
PHOSPHOROUS	1.33	0.79	0.64	
PLUTONIUM	48.01			28.50
POTASSIUM	0.13	0.16		
SILICON	0.17	0.16		
SODIUM				
SULPHUR	0.13	0.14		
TANTALUM	-	-		
TITANIUM		0.02	0.03	
TUNGSTEN		0.09	0.01	
URANIUM	0.38	1.03	1.00	
ZINC	0.32	0.20	0.22	
ZIRCONIUM	-	-		

R440

	XRF1	ICPAES	ICPMS	CAL/ISO
	weight %	weight %	weight %	weight %
ALUMINUM	0.15	0.02	0.03	
AMERICIUM	0.35			0.33
CALCIUM	0.35	0.14		
CHLORINE				
CHROMIUM		0.02	0.04	
COPPER		-	-	
GALLIUM			-	
IRON	0.24	0.22	0.28	
MAGNESIUM	16.66	5.56	0.14	
MANGANESE			-	
NICKEL	0.13	0.05	0.06	
PHOSPHOROUS	1.27	0.02	0.02	
PLUTONIUM	70.95			54.14
POTASSIUM		-		
SILICON		0.02		
SODIUM				
SULPHUR		0.01		
TANTALUM		-	-	
TITANIUM		0.05	0.07	
TUNGSTEN		-	-	
URANIUM	0.31	0.14	0.11	
ZINC		-	-	
ZIRCONIUM		0.02	-	



*Sample is saturated in both AES and MS

	XRF1	XRF2	ICPMS	CAL/ISO
	weight %	weight %	weight %	weight %
ALUMINUM			0.01	
AMERICIUM	0.30	0.20		0.17
CALCIUM			0.13	
CHLORINE			0.02	
CHROMIUM			0.03	
COPPER			-	
FLUORIDE			0.01	
GALLIUM			-	
IRON	0.20	0.20	0.14	
MAGNESIUM			0.01	
MANGANESE			-	
NICKEL			0.01	
PHOSPHOROUS			0.01	
PLUTONIUM	79.40	80.50		84.60
POTASSIUM				
SILICON			0.09	
SODIUM			0.04	
SULPHUR				
TANTALUM			-	
TITANIUM			-	
TUNGSTEN			-	
URANIUM				
ZINC			-	
ZIRCONIUM			-	

S1856



Sample for
ICPMS did
not dissolve.

X2165

	XRF1	XRF2	XRF"B"	ICPAES	ICPMS	CAL/ISO
	weight %	weight %	weight %	weight %	weight %	weight %
ALUMINUM	0.58	0.47	0.33	0.36	0.37	
AMERICIUM	0.21	0.20	0.23			0.22
CALCIUM	0.69	0.73	0.50	0.04		
CHLORINE						
CHROMIUM	0.70	0.75	0.74	-	0.01	
COPPER				-	-	
GALLIUM				-	0.02	
IRON	1.21	1.26	0.33	0.05	0.07	
MAGNESIUM				-	-	
MANGANESE				-	-	
NICKEL	0.18	0.20	0.18	-	-	
PHOSPHOROUS				-	0.01	
PLUTONIUM	40.71	41.15	42.11	33.0(IDMS)		34.30
POTASSIUM	0.20	0.21	0.18	0.17		
SILICON	3.73	3.16	2.72	0.60		
SODIUM						
SULPHUR				-		
TANTALUM	33.07	31.31	31.70	0.21	0.49	
TITANIUM	0.28	0.25	0.22	-	-	
TUNGSTEN				-	0.02	
URANIUM				0.02	-	
ZINC				-	-	
ZIRCONIUM	0.08	0.09	0.10	-	-	



Future Plans to Resolve Analytical Issues

- Continue to send more MIS samples for XRF:
(Items ARF223, ARF365, MISNE4, and O3038 are “on their way” to CMR for XRF)

- Couple ICPMS and ICPAES with XRF:
(send undissolved heel to XRF,
dissolved solution) to ICPMS and ICPAES)